Working Meeting to Address HIPPI-6400 Issues Only
Wednesday and Thursday, July 10-11, 1996
Mountain View, CA

1. Opening remarks and introductions

The Chairman, Don Tolmie of Los Alamos National Laboratory, opened this HIPPI-6400 meeting and thanked Greg Chesson and Silicon Graphics Inc. for hosting this meeting. This group is constituted as both the HIPPI special working group (SWG) under X3T11, and the HIPPI Networking Forum (HNF) - Technical Committee (TC).

Don then lead a round of introductions. The list of attendees is at the end of these minutes.

2. Review / modify the draft agenda

The draft agenda on the web was updated with the inclusion of item 4.6.1, Patent issue for 4b/5b coding, 4.9.1, HP patent issue for OS Bypass, and the August and September meetings as 8.1 and 8.2 respectively. These minutes reflect the approved agenda.

3. Review minutes of previous meetings

3.1 June 10-11, Santa Fe

Don Tolmie asked if having the minutes available in HTML format was necessary, and no one at the meeting felt the need for it; getting their copy in PDF format was sufficient. Don will drop the HTML version in the future unless he receives e-mail requests from other people that HTML is necessary (i.e., if you want it in HTML format then send e-mail to det@lanl.gov or it will be gone in the future).

The Santa Fe minutes were reviewed. Roger Ronald of E-Systems noted the omission of his action item to present for discussion over e-mail E-Systems ideas on a HIPPI-6400 Fiber Extender. No other changes were noted. Greg Chesson of Silicon Graphics moved, and Wally St.John of Los Alamos seconded, to approve the minutes as corrected. Passed unanimously.

3.2 Review action items from Santa Fe meeting

1. Stan Swirhun, and others, to consider problems with FRAME signal frequency in optical implementations. (Carryover)
2. Greg Chesson to provide Don Tolmie with the parallel CRC equations to be added as an annex. (Carryover)
3. James Hoffman to verify CRC error protection results. (Carryover)
4. Roger Ronald to define Admin micropacket contents and requirements and present to e-mail. (Carryover)
5. Greg Chesson and SGI to check to see if it is OK to include the Header micropacket in the ECRC calculation. (Done, include it)
6. Greg Chesson, and James Hoffman, to check the low frequency limit of the 4b/5b code. (Done)
7. Greg Chesson and SGI to specify the order that bits are fed into the LCRC calculation. (Carryover)
8. Greg Chesson and SGI to provide text on what actions occur as a result of a Shutdown. (Carryover)
9. Greg Chesson and SGI to check the initial pattern for Reset operations and the need for the 10 second line-charge time. (Carryover)
10. Greg Chesson and SGI to see if it is OK to remove the 10 second line-charging delay during a Reset operation. (Lumped with item 9 above.)
11. Greg Chesson and SGI to review the error conditions in 9.1. Check the grouping, ordering, names, and field sizes. (Carryover)
12. Greg Chesson and SGI to review the Scheduled transfers in clause 7 with special attention to Bufx. (Carryover)
13. Greg Chesson to provide ARP text for inclusion in HIPPI-6400-SC. (Carryover - Greg will distribute the ARP documents)
14. Greg Chesson to draft initial text for bridging. (Carryover)
15. Don Tolmie to update HIPPI-6400-PH Rev 0.25 with the changes agreed to at the Santa Fe meeting. (Done)
16. Roger Ronald to update HIPPI-6400-SC Rev 0.2 with the changes agreed to at the Santa Fe meeting. (Done)
17. Roger Ronald to present over e-mail for discussion E-Systems ideas on a HIPPI-6400 Fiber Extender. (Done)

4. Review HIPPI-6400-PH changes since last meeting (reference HIPPI-6400-PH Rev 0.3)

4.1 Minor changes first and then return to the more detailed ones

Figure 1, change location of Original Source and Final Destination for non-HIPPI-6400 end-points - also agreed to change name from “Gigabit Ethernet Node” to “Other Media Node”.

Figure 5, addition of box showing transition of TSEQ to RSEQ for feedback acknowledgments - accepted.

Table 1, addition of "Header" in the ECRC coverage - also agreed to change commas to “and” to show additive nature.

Last sentence of 6.1, 3rd paragraph concerning which parameters come from the Originating Source - accepted with slight modification.

Table 2 changes: Data micropacket, data bytes contents addition of "or Schedule Parameters” - accepted.

Table 2 changes: changed "single" to "accumulating" for Header and Admin micropackets ECRC - accepted for Header but not for Admin.

Last sentence of 6.4, first paragraph, about TSEQ = 0 after a Link Reset - accepted.

4.2 CRCs and LCRC (pages 12-13)

First sentence of 2nd paragraph of 6.6.1 about ECRC checking "all of the data bytes of a Message" - accepted given the definition of “data bytes” in Figure 3.

Third paragraph about "other documents may require intermediate ..." - accepted.

In 6.6.2, last paragraph, the qualifier about the stomp code was removed - accepted.

Addition of Figure 9 showing the ECRC implementation - accepted.

In 6.6.2.1 and 6.6.2.2 the Stomp code was called out separately for the Source and Destination, and made optional rather than mandatory. The group asked for minor word changes and for section 6.6.2.2 to be made mandatory.

In 6.6.3, the last part of the 2nd paragraph about the ECRC being initialized before each Header micropacket was added but then deleted by the group who felt the addition increased confusion.

4.3 Checking for errors (page 24-25, 34)

In 9.1 the error checking was broken up into three groups instead of the two groups suggested in Santa Fe. The groups are in a priority basis, but there is no ordering within a group. At the meeting the group agreed to add the TSEQ checking as a second prioritized section (9.1.2) after the LCRC check.

9.1.1 covers LCRC errors. Added concept of "syndrome ≠ xxx". Stomp code text was also inserted to stay consistent with 6.6.2.2.

9.1.2(3) which covered ECRC errors was accepted with an introduction addition and renumbered 9.1.3.

9.1.3(4) covers the miscellaneous errors, and there is no specific ordering to them now - accepted.

TYPE = unspecified between x'8' - x'F' had major text changes based on e-mail comments from Jim Davis of E-Systems - accepted.

Taking wrap into account for TSEQ not one greater was accepted for the next error case.

The case of missing the Header micropacket was extensively reworded based on e-mail comments from Jim Davis of E-Systems. Jim Davis also took an action item to fix the text describing "End of Message" missing.

The time-out value of 2 seconds for stalled data was discussed and accepted until further information requires a change.

The summary of logged errors in table 9, page 34, was reviewed. Don based the names and field sizes on text in the SuMAC specification. All 4-bit fields were changed to four 1-bit fields, one per VC. Accordingly, names were also changed to show the specific VC that was in error.

The summary of time-outs in table 10, page 34, was reviewed. The question of whether the table was complete, and if the items were correct, was asked. It was decided to remove the programmable column and ask that vendors make all time-outs programmable with a specific minimum resolution.

The tables are referenced in clause 13, Maintenance and control features, on page 33.

4.4 Initialization, Reset, Shutdown (pages 31-33)

The last sentence of clause 12 was reviewed as well as the definition of "administrator" in 3.1.2. It was agreed that “administrator” only has a single meaning and need not be capitalized.

In 12.1, "Reset" was changed to "Link Reset" globally. Other wording changes were reviewed.

The addition of which micropackets are discarded during Link Reset and Initialize operations was reviewed.

It was decided to not log errors during a Link Reset operation to assist causal analysis, except during a “Power On” Link Reset.

The changes to figure 15, the flow diagram for the Initialize and Link Reset operations, were reviewed. A minor drawing error was corrected and a tests for “Reset_ACK” and “Initialize_ACK” were added to remove a possible deadlock situation.

The Link Shutdown text in 12.3 was accepted.

4.5 Training sequence (page 30-31)

Changed title of clause 11 from "Dynamic skew compensation" to "Link training".

The sentence about Disparity Count being set to zero at the end of a training sequence was accepted.

The sentence about an unsuccessful training sequence causing Link Rest was rejected.

Figures 13 and 14 were reviewed as to the length and actions during a training sequence. Hansel Collins of SGI took an action item to finalize the training sequence. Joe Parker of Optivision took an action item to query fiber cable and connector vendor as to a reasonable skew adjustment requirement.

4.6 Consideration of 8b/10b coding (page 28)

At the Santa Fe meeting, Al Widmer of IBM described a problem with the 4b/5b coding where certain data strings could cause a very low frequency waveform component. Al proposed that we switch from the 4b/5b coding to a subset of the 8b/10b coding used in Fibre Channel.

Using Al Widmer's worst case waveforms, James Hoffman of Los Alamos considered a change to the 4b/5b coding where the code was forced to at least cross the zero threshold rather than remaining at one polarity. The result was a minuscule improvement in some areas, degradation in others, and an increase in implementation complexity. This has been rejected.

James Hoffman also did Fourier analysis on the waveforms and showed his results. They can be viewed at:
http://www.cic-5.lanl.gov/~jamesh/hippi64/

Greg Chesson of SGI investigated the gate count to implement the 8b/10b coding and reported at least a five times increase on the source side with a matching count at the receiver side. The conclusion, based on studies to date and the imminent chip fabrication, was to continue using the 4b/5b coding unless we are shown that it is broken.

4.6.1 Patent issue for 4b/5b coding

Francois Gaullier of Hewlett-Packard is pursuing a possible patent infringement issue of the 4b/5b coding on an existing HP patent. Francois reported that if an infringement were found, HP would extend the same non-discrimination one-time fee as issued for HIPPI-Serial.

4.7 Definitions (page 2)

The definitions that were modified were reviewed.

administrator - accepted in lower case form.

Final Destination - accepted.

Originating Source - accepted.

Virtual Connection - accepted

New definitions for the following terms were reviewed.

Block, Transfer - agreed to with the addition of “within a Scheduled Transfer”.

log - accepted.

Message - all messages must consist of two or more micropackets, hence a text change from “one or more” to “two or more”.

Scheduled Transfer - reworded so the defined term doesn’t appear in the definition.

It was noted that some of the specific words in the document have been changed to start with a capital letter, and people were asked their opinions of this.

It was also noted that the word "Transfer" is overloaded, and as we go through the Scheduled Transfer portion of the document we should keep this in mind and consider other terms.

4.8 Header micropackets contents (pages 14-15)

The wording changes in 6.7.2 were reviewed - accepted but note that the “Key” field was split into the "Key" and "T-id" fields.

The changes to table 4 were reviewed and the group agreed to split the table so the “Second micropacket” portion appears in 6.7.3 Schedule Parameters.

Removing "HIPPI-6400" before MAC Header and Schedule Header - accepted.

The “Ethertype” field was changed to “Protocol” as it may hold different 16-bit protocol designators, e.g., Ethertype and ULP. Michael McGowen took an action item to detail the use of the “Transtype” parameter.

The changed text in 6.7.3, Schedule Parameters, was reviewed - and only a minor change to B-num resulted.

Unused fields transmitted as zeros - accepted.

T-len field renamed to Len, and used for both transmission length in some operations and destination Bufx size in others, was accepted.

Both Source and Destination ULA (Universal LAN Address) fields and a second “EtherType” field were added to the second micropacket. Michael McGowen took an action item to describe the fields and their usage.

4.9 Scheduled transfers (pages 16-22)

The changes to Table 5, the summary of the Schedule operation parameters, were reviewed.

The group noticed a flaw in the RQP and RQP_Response operations. The RQP_Response does not contain a binding key for the receiver. The RQP also needs to supply the aforementioned key. By adding a key to each operation, a full duplex key exchange exists allowing either side to start the Scheduled Transfer. A new semantics is also required in the table to display the dual directionality.

The 32-bit “Key” field was broken into two 16-bit fields, Key and Transfer ID. The Key will now be bound on a Virtual Connection basis and the T-id will allow different bindings on a Scheduled Transfer basis. The Key field may be different, but the T-id should be the same on both sides. This now allows the “Abort” command to cancel a specific Scheduled Transfer on a Virtual Connection.

The current Scheduled Transfer operations only allow for a “Push” from one side to the other and not a “Pull”. Greg Chesson noted that after a RQP_Response, enough information has been exchanged (Bufx ranges), so that an unsolicited CTS could emulate “Pull”.

James Hoffman of Los Alamos took an action item to finish an informative annex dealing with scheduled transfers – specifically, including examples, detailing the use of Bufx and Offset, and describing methods for dealing with related errors.

4.9.1 Patent issue for Scheduled Transfer

Francois Gaullier of Hewlett-Packard is pursuing a possible patent infringement issue of the HIPPI-6400 Scheduled Transfer on an existing HP patent. Greg Chesson took an action item to provide prior art examples to Francois for dissemination and analysis by HP’s lawyers.

4.10 Resume discussions on items deferred in 4.1

After working with the document for a while, people were polled as to their likes and dislikes for capitalizing key words. The group decided that the document capitalization is fine as it stands (Rev 0.3).

5. HIPPI-6400-SC

5.1 Review HIPPI-6400-SC changes since last meeting (reference HIPPI-6400-SC Rev 0.3)

Roger Ronald of E-Systems, the Technical Editor, reviewed changes to the document and additional changes were agreed to.

5.2 Addressing

In-band vs. out-of-band switch management was debated. It was agreed that initially switch control and bootstrap operations would use Admin micropackets for determining:

- link status
- the device on the other side of each link

- getting a logical address

HIPPI-6400 would use existing mechanisms for ARP and Reverse ARP.

Michael McGowen suggested reviewing HIPPI-AC for techniques describing the above items and for topology discovery by switches. Michael took an action item to send Don Tolmie an electronic version of HIPPI-AC for posting in Don's HIPPI document web page.

6. Copper interconnect (2 pm - 9 pm Thursday)

Some new attendees arrived so introductions were done again, and thanks again extended to SGI for hosting the meeting.

6.1 Brief overview of requirements

As a starting point, Don Tolmie presented the list of items generated at the end of the copper portion of the HIPPI-6400 meeting in Santa Fe. The list included:

1. 22 signals wide @ 500 Mbit/s (each direction)
2. Distance = 10, 25, 50 meters
3. Cable O.D. ≤ 0.6"
4. Bend Radius ≤ 6"
5. Plenum rated
6. Full-duplex in one connector/cable
7. Footprint ≤ a single HIPPI-800 connector
8. Impedance = 150 ohm differential
9. AC coupled
10. Equalizer is acceptable
11. Include power pins for optical repeater
12. Pass FCC Class A and CISPRA
13. Electrical levels Low Voltage PECL (TBD)
14. Nail down electrical levels by 7/1/96
15. Specification available 10/96
16. Parts in place 1Q97

Greg Chesson updated item 14 of this list by saying that SGI is planning for 2.5V peak-to-peak output swings.

6.2 Presentations

James Hoffman of Los Alamos presented his analysis of the 4b/5b coding. The results can be viewed at: http://www.cic-5.lanl.gov/~jamesh/hippi64/. People were unsure how this would translate into real-world waveforms, and what filtering out the low frequency components would to the jitter.

Ron Nikel of SGI described a circuit that he was proposing for the cable. The Source side was capacitor coupled and had an RC peaking network. Comments about preferring the peaking network at the receiver end to use the maximum signal strength were made. A resistive divider terminated the 150 Ω cable at the receiver end. The methods used to terminate the individual and overall shields were unclear, and need more work.

Gene Dornhoff of Los Alamos described a test system that Los Alamos is building around a HIPPI Tester. It will be able to drive a small number of signals with predetermined patterns up to several kilobits long. For example, it could be used to compare the 4b/5b and 8b/10b coding schemes. Gene stated that he hoped to have eye patterns available for the August meeting. At a later date additional receiver logic will be included to allow full bit error rate testing with the different patterns.

Ed Cady of Berg passed around sample 100-position connectors (some with cable attached) that Berg was proposing for HIPPI-6400. It was felt that an angled cable entry was needed to keep rack door clearance reasonable. Ed proposed a latch, rather than jackscrews, to hold the connector. The latch will hold up to 35 pounds, and should work with our large size cable. It was noted that the cable diameter was larger than the connector, and may require over-molding for fabrication. The overall connector dimensions were 2.13" x 0.515". It would be possible to include equalizers in the back shell, but then the back shell would probably need to be longer yet, and also a custom design. Greg Chesson questioned the maximum number of mating cycles, and was told that it was greater than 10,000.

Herb VanDeuson of W.L.Gore presented their cable based on 4 conductors per shield. They are also working on a cable called Eye-Opener Plus which gives longer distances, albeit with somewhat higher prices.

Michael Leib of Technitrol presented information on equalizers. Passive equalizers helped considerably, and the active equalizers could almost double the distance. The proposed equalizer packages for HIPPI-6400 had 11 circuits per package; 4 packages are required at each end. The active package was 0.56" x 1.5" x 0.185" and required a nominal 250 ma. The passive package was 0.3" x 1.5" x 0.145". Michael also passed out information on transformers. Greg Chesson expressed a strong preference for having any special equalization circuitry outboard from the logic cards. The size of the equalizers, and the small size of the connector, probably precludes putting the equalizers in the back shell. Mounting the equalizers

in an external box seems reasonable, probably rack mounted but also possible for under the floor.

6.3 Work planning

To stimulate discussion, Don Tolmie proposed some values for some of the parameters, and this led to the following issues.

1. General -

- System data rate = 6400 Mbit/s. No discussion.

- Number of signals in each direction = 22. Bob Newhall of SGI requested an additional signal in each direction for detecting connectivity and power-on (in copper media systems only, not needed in fiber systems). The signal would be a square wave rather than d.c. to pass through the coupling networks. At the receiver it would be used to gate off the logic receivers and prevent noise from causing problems. Bob did not want to use an existing signal, saying that an additional load would probably cause signal problems. No objections were raised to adding this additional signal to the copper specification.

- Nominal bit rate per line = 500 Mbit/s. No objections.

- Bit rate tolerance = ± 200 ppm. Hansel Collins of SGI took an action item to check this value.

- CLOCK symmetry = 50% ± 5%. Hansel Collins took an action item to check this value.

- Peak jitter ≤ 0.05 ns. Hansel Collins took an action item to check this value.

2. Cable -

- Length = 10, 25, 50 meters. No objections.

- Type = shielded twisted pairs? / mini-coax? twin-ax ? It is too soon to select one.

- Number of signal paths in a cable was changed from 44 to 46 to accommodate the new interconnect signal.

- Impedance = 150 Ω ± 6 Ω for STP? 75 Ω ± 3 Ω for coax ? It is too soon to select one.

- Differential skew was specified as pair-to-pair skew ≤ 70 ps per meter.

- Attenuation ≤ 0.4 dB per meter at 500 MHz. No discussion.

- Overall diameter ≤ 0.65 ". This was raised from the value of 0.6" stated in Santa Fe.

- Plenum rating and jacket material questions led to specifying CL-2/FT4 rated.

- Bend radius ≤ 6". No discussion.

3. Transmitter -

- Output voltage max. = 2.5 V peak-to-peak differential.

- Output voltage min. = 0.6 mV peak-to-peak. Hansel Collins of SGI took an action item to check this value.

- Deterministic jitter = 10% peak-to-peak. Hansel Collins took an action item to check this value.

- Random jitter = 10% peak-to-peak. Hansel Collins took an action item to check this value.

- Rise/fall time = 0.6 ns (20 - 80%). Hansel Collins took an action item to check this value.

4. Receiver -

- Sensitivity ≤ 250 mV.

- Maximum input voltage = 2.5 V.

- Common mode range ? Hansel Collins took an action item to determine this value.

5. Equalizer -

It was agreed that equalizer information should be put in an annex rather than the body of the document. The intent is to make it so that everyone can use the same techniques if they need equalizers for longer cable runs, but not mandate equalizers on every board.

6. Connector -

After considerable discussion it was recognized that we had accepted the Berg connector for HIPPI-6400. There were no objections when this was pointed out.

- Number of pins = 100. No objections.

- Loss = ? Ed Cady of Berg took an action item to determine this value.

- Crosstalk = ? Ed Cady took an action item to determine this value.

- Outside dimensions ≤ 2.5" x 0.75". It was noted that we wanted to work with PCI card spacing.

- Maximum d.c. current per pin ≥ 1 A. There was a desire to be able to power external logic, e.g., equalizers or fiber adapters, through the connector. Problems included (1) there are only a few uncommitted pins, (2) specifying specific voltage values useful for all cases, and (3) providing that voltage, and power, from the circuit board and system. Craig Davidson of E-

Systems took an action item to propose the voltage and current levels needed.

- The 100 pins were assigned as: 92 = signals, 3 = power, 3 = ground, and 2 = shield. Craig Davidson took an action item to propose the specific connector pin assignments.

- Latches, rather than jackscrews, will hold the connector in the mated position.

- RFI/EMI shielding will be included.

- Mating cycles ≥ 10,000.

- Cable exit at approximately 60 degrees. This will be in an annex.

Steve Forman of Berg took an action item to provide Don Tolmie with the necessary connector drawings for inclusion in HIPPI-6400-PH.

Don Tolmie took an action item to provide ANSI patent release forms to Steve Forman of Berg.

7. Other "Open Issues" not covered yet

None, we ran out of time and energy.

8. Future meeting schedule

Chris Olson and Lockheed Martin agreed to host an interim HIPPI-6400 working meeting, January 8-9, 1997, in Phoenix. Steve Forman and Berg agreed to host March 5-6, 1997; location to be determined.

8.1 August 5-6, 1996, Honolulu, HI

During the X3T11 August plenary week , the following HIPPI meetings are scheduled:
Monday, August 5 -
9 AM - 1 PM — Fibre Channel, HIPPI, & IPI tutorial
9AM - 12noon — HNF for Asia-Pacific Group
1 PM - 9 PM — HIPPI-6400
Tuesday, August 6 -
8 AM - 9 AM — HIPPI-6400 Optical background
9 AM - 10 AM — HNF Plenary
10 AM - 3 PM — HIPPI-TC General and -6400
3 PM - 6 PM — HIPPI-6400 Optical
6 PM - 9 PM — HIPPI-6400 Copper
The location is the Ala Moana Hotel, 410 Atkinson Drive, Honolulu, Hawaii 96814-4722, phone (808) 955-4811, Fax (808) 944-2974. The rate varies from $110 to $142, and the group name when making reservations is ANSI/X3T11/Hitachi. Paul Boulay and Hitachi are the host.

8.2 September 11-12, 1996, Albuquerque, NM

A meeting to discuss just HIPPI-6400 issues will be held September 11-12, 1996.
Wednesday, September 11 -
2 PM - 9 PM — HIPPI-6400
Thursday, September 12 -
9 AM - 2 PM — HIPPI-6400
2 PM - 7 PM — HIPPI-6400 copper
The location is the Best Western Fred Harvey Hotel (at the Albuquerque airport), 2910 Yale Blvd, Albuquerque, NM 87119-9126, phone (505) 843-7000, fax (505) 843-6307. The rate is $85 single, $95 double. The group name is X3T11/Los Alamos, and the cutoff date for reservations is August 20.

9. Review action items

All of the following action items apply to HIPPI-6400.

1. Stan Swirhun, and others, to consider problems with FRAME signal frequency in optical implementations.
2. Greg Chesson to provide Don Tolmie with the parallel CRC equations to be added as an annex.
3. James Hoffman to verify CRC error protection results.
4. Roger Ronald to define Admin micropacket contents and requirements and present to e-mail.
5. Greg Chesson and SGI to specify the order that bits are fed into the LCRC calculation.
6. Greg Chesson and SGI to provide text on what actions occur as a result of a Shutdown.
7. Greg Chesson and SGI to check the initial pattern for Reset operations and the need for the 10 second line-charge time.
8. Greg Chesson and SGI to review the error conditions in 9.1. Check the grouping, ordering, names, and field sizes.
9. Greg Chesson and SGI to review the Scheduled transfers in clause 7 with special attention to Bufx.
10. Greg Chesson to provide ARP text for inclusion in HIPPI-6400-SC.
11. Greg Chesson to draft initial text for bridging.
12. Greg Chesson to provide examples of OS Bypass prior art to Francois Gaullier of HP.
13. Jim Davis of Raytheon E-Systems to propose text for the “missing end of Message” error text in 9.1.4.

14. Joe Parker of Optivision to query fiber cable and connector vendors as to a reasonable skew adjustment requirement.
15. Michael McGowen of Essential Communications to detail the use of the "Transtype" parameter.
16. Michael McGowen to describe the ULA and EtherType fields and their usage.
17. Michael McGowen to send Don Tolmie an electronic copy of HIPPI-AC for placement on the HIPPI web page.
18. James Hoffman of Los Alamos to finish an informative annex dealing with scheduled transfers – specifically, including examples, detailing the use of Bufx and Offset, and describing methods for dealing with related errors.
19. Roger Ronald to propose uses for Admin micropackets.
20. Von Welch of NCSA to provide a draft HIPPI-6400 MIB.
21. Hansel Collins of SGI to finalize the training sequence.
22. Hansel Collins to check the ± 200 ppm bit rate tolerance value.
23. Hansel Collins to check the 50% ± 5% CLOCK symmetry value.
24. Hansel Collins to check the 600 mV minimum output voltage value.
25. Hansel Collins to check the 10% deterministic jitter value.
26. Hansel Collins to check the 10% random jitter value.
27. Hansel Collins to check the ≤ 0.05 ns peak jitter value.
28. Hansel Collins to check the 0.6 ns (20-80%) rise and fall time values.
29. Hansel Collins to determine the receiver's common mode range.
30. Craig Davidson of Raytheon E-Systems to propose the voltages and currents necessary at the connector.
31. Craig Davidson to propose the connector pin assignments.
32. Ed Cady of Berg Electronics to determine the connector loss value.
33. Ed Cady to determine the connector crosstalk value.
34. Steve Forman of Berg Electronics to provide Don Tolmie with the necessary connector drawings for inclusion in HIPPI-6400-PH.
35. Don Tolmie to provide ANSI patent release forms to Steve Forman of Berg Electronics.
36. Don Tolmie to update HIPPI-6400-PH Rev 0.3 with the changes agreed to at the Mountain View meeting.
37. Roger Ronald to update HIPPI-6400-SC Rev 0.3 with the changes agreed to at the Mountain View meeting.

10. Adjournment

The meeting adjourned at 7:30 PM on Thursday evening after an intense and fruitful two days.

Attendees:

(Those marked with a * attended only the copper portion of the meeting.)

Ed Cady	*	Berg Electronics
Steve Foreman	*	Berg Electronics
Barbara Weber	*	Berg Electronics
Gary Klesk		Cray Research
Jeff Young		Cray Research
Mark Parenti		Digital Equipment Corp
Bob Williard		Digital Equipment Corp
Michael McGowen		Essential Communications
Bob Pearson		Essential Communications
Barbara Reed		Golden Gate University
Francois Gaullier		Hewlett-Packard
Chris Olson		Lockheed Martin
Gene Dornhoff		Los Alamos National Lab
James Hoffman		Los Alamos National Lab
Wally St.John		Los Alamos National Lab
Don Tolmie		Los Alamos National Lab
Von Welch		NCSA
Joe Parker		Optivision
Craig Davidson		Raytheon E-Systems
Jim Davis		Raytheon E-Systems
Richard Ellison	*	Raytheon E-Systems
Roger Ronald		Raytheon E-Systems
Greg Chesson		Silicon Graphics
Hansel Collins		Silicon Graphics
Bob Newhall		Silicon Graphics
Ronald Nikel	*	Silicon Graphics
Dave Parry		Silicon Graphics
Don Sanders		Silicon Graphics
Michael Leib	*	Technitrol/Pulse
Herb Van Deuson	*	W.L. Gore